

REMARKS/ARGUMENTS

Previously presented Claims 1, 2, 7-9, 11-13, and 15 and new Claim 19 are pending in the Application. Claims 3-6, 10, 14, and 17-18 were previously cancelled. Claim 15 which is directed to an invention non-elected in response to a restriction requirement and was withdrawn from further consideration by the Examiner is hereby cancelled without prejudice or disclaimer in favor of divisional prosecution. Previously presented Claims 1, 2, 7-9, 11-13, and 16 have not been amended.

New Claim 19 is previously presented Claim 1 wherein the titanium alloy material is closed by the transitional phrase “consisting essentially of” to elements other than those named in the claim which materially alter the basic and novel characteristics and properties of the titanium alloy material. *In re Herz*, 537 F.2d 549, 551-52 (CCPA 1976); *AK Steel Corp. v. Sollac*, 344 F.3d 1234, 1239 (Fed. Cir. 2003).

No new matter is added.

Applicant appreciates the Examiner’s withdrawal of all previous rejections of the previously presented claims under 35 U.S.C. § 112, 1st and 2nd paragraphs, and under 35 U.S.C. § 103 over the combined teachings of Miyamoto (EP 1126139 A2, published August 22, 2001) in view of Grunke (U.S. Patent 4,936,927, issued June 26, 1990), Lutjering (“Titanium”), and Yao (U.S. Patent 6,066,359, issued May 23, 2000), optionally further in view of Kobayashi (EP 0 816 007 A2, published January 7m 1998). Thank you.

However, the Examiner entered the following new grounds of rejection:

(1) Claims 1, 7, 9, 11, and 12 are newly rejected under 35 U.S.C. § 103 over Bomberger (U.S. 3,113,227, issued December 3, 1963) or Miyamoto (EP 1126139 A2, published August 22, 2001) in view of Taki (U.S. Patent 5,395,461, issued March 7, 1995).

(2) Claim 8 is newly rejected under 35 U.S.C. § 103 over Bomberger or Miyamoto in view of Taki, and further in view of Ledoux (EP 0 267 349 A1, published May 18, 1988, English Abstract).

(3) Claims 13 and 16 are newly rejected under 35 U.S.C. § 103 over Miyamoto in view of Taki.

Applicant respectfully asks the Examiner to reconsider the new grounds of rejection and withdraw them in light of the evidence of record and the following remarks and arguments.

Preliminary Remarks Regarding The Finding of Inherency

The Examiner's new rejections are all based on the following statements (Office Action dated August 11, 2010 (OA), pages 4-5, bridging paragraph; emphasis added):

"[W]here the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, a *prima facie* case of either anticipation or obviousness has been established" (*In re Best*, 562 F.2d 1252, 1255 . . . (CCPA 1967)). It follows that when the same process is applied to the same starting materials, the resulting products would be expected to inherently possess the same properties absent evidence to the contrary.

The Examiner finds that the titanium alloy material which forms the heat exchanger Applicant claims inherently has the same or substantially the same structure, composition, properties, and utility as the titanium alloy materials with overlapping Al content described by Bomberger or Miyamoto because the prior art titanium alloy materials were produced by the same or substantially the same method. The Examiner's findings of inherency are based on clearly erroneous findings that the claimed and prior art titanium alloy materials are made by the same or substantially the same methods and clearly erroneous findings that the prior art titanium alloy materials are the same or substantially the same as the titanium alloy materials defined in Applicant's claims. Accordingly, the Examiner's conclusions of obviousness in view of the combined prior art are clearly erroneous.

In re Oelrich, 666 F.2d 578, 581 (CCPA 1981), teaches that inherency may not be established by probabilities or possibilities. Something that is inherent must inevitably be the result each and every time. The fact that certain compositions or properties may be produced by the same or a similar prior art process generally described by the prior art is not sufficient to establish that the compositions or properties are inherently produced by that process. *In re Rijckaert*, 9 F.3d 1531, 1534 (Fed. Cir. 1993). “To establish inherency, the extrinsic evidence ‘must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.’” *In re Robertson*, 169 F.3d 743, 745 (Fed. Cir. 1999)(citations omitted). An invitation to experiment is not an inherent disclosure. *Metabolite Labs., Inc. v. Lab. Corp. of Am. Holdings*, 370 F.3d 1354, 1367 (Fed. Cir. 2004).

When relying on a theory of inherency, the Examiner must provide a reasonable factual basis and/or technical reasoning which supports a finding that the allegedly inherent material or characteristic necessarily flows from the teachings of the applied prior art. *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990)(emphasis added). Here, the Examiner’s new rejections of Applicant’s claims are based on clearly erroneous findings of inherency based on underlying findings of fact which are themselves clearly erroneous. The rejections should be withdrawn.

1. Rejections of Claims 1, 7, 9, 11, and 12 under
35 U.S.C. § 103 over Bomberger or Miyamoto and Taki

Claims 1, 7, 9, 11, and 12 are newly rejected under 35 U.S.C. § 103 over either Bomberger or Miyamoto combined with Taki. For the reasons stated below, the rejections should be withdrawn.

First, the Examiner finds that Bomberger describes titanium (Ti) alloys which are resistant to hydrogen absorption at temperatures up to 400°C (Bomberger, col. 1, ll. 11-17), may contain as little as 3% Al (Bomberger, cols. 9-10, Claims 2-5), and may be prepared by a method comprising annealing and air oxidizing. For a description of the preparatory method, the Examiner cites Bomberger's teaching at column 9, lines 31-35 (emphasis added):

[These alloys] are inherently relatively resistant to hydrogen pickup at elevated temperatures up to 400°C, particularly when vacuum annealed and thereafter air oxidized. Also they are not embrittled by hydrogen pickup.

However, Bomberger's teaching at column 9, lines 31-35, specifically relates to the known Ti-Al-Zr alloys described at column 9, lines 23-28 (emphasis added), "As shown in the above test results, preferred alpha alloys for purposes of the invention are those containing zirconium, preferably together with aluminum and/or tin." The one and only Ti-Al alloy Bomberger appears to have tested (Bomberger, Table 1, col. 2, ll. 42-58) which has an Al content of 3.0% or less is B120VCA with an Al content of 2.8%, a V content of 12.21%, and a Cr content of 10.8% (Bomberger, Table 1, col. 2, ll. 42-58). B120VCA is said to be a beta-type Ti-Al alloy (Bomberger, col. 2, ll. 71-72) which Bomberger suggests is inherently more susceptible to hydrogen absorption than its preferred alpha-type Ti-Al alloys (Bomberger, col. 5, ll. 65-75) and which Bomberger never exposed or contemplated exposing to an oxygen-containing atmosphere (Bomberger, Table II, cols. 3-4; Table IV, cols. 5-6). The Ti-Al alloys of new Claim 19 are closed to the elements Zr, V, and Cr in amounts which materially alter the basic and novel characteristics of the alloy.

The Examiner also finds that Miyamoto describes titanium (Ti) alloys which contain 0.5-2.3 mass% Al (Miyamoto, Abstract; [0008-0009; 0020-0022]) and are prepared by oxidizing at an elevated temperature of about 700°C (Miyamoto [0039]). The Examiner specifically relies upon the following Miyamoto teaching [0039]:

The plate made of the Ti-Al two-element alloy and produced in the item (1) was used to examine the oxidation-resistance thereof. The alloy was heated at 700°C for 20 hour or 700°C for 40 hours in the atmosphere.

Then, the critical finding by the Examiner in this case is (OA, pp. 4-5, bridging ¶):

In the present instance, Bomberger . . . and Miyamoto . . . teach the process as claimed in claim 15, which is recited as being sufficient to form the alloy of claim 1. Therefore, one of ordinary skill in the art would have expected the processes of Bomberger . . . and Miyamoto . . . to have produced the claimed alloy, as they teach processes and starting materials substantially identical to that of the claimed process.

Since the Examiner finds that Bomberger and Miyamoto each respectively describes oxidizing a Ti-Al alloy comprising a mass% of Al which overlaps the mass% of Al in the Ti-Al alloy materials which form Applicant's claimed heat exchanger and also finds that each prior art reference anticipates the process defined by withdrawn Claim 15 which is said to produce the titanium alloy material of Claim 1, the Examiner finds that titanium alloy materials with the same or substantially the same Al content made by methods which are made by the same or substantially the same methods must themselves inherently be the same or substantially the same. The Examiner's findings of fact are clearly erroneous. The Examiner's conclusions of obviousness based on the clearly erroneous findings of fact are erroneous.

Persons having ordinary skill in the art would have understood that an aluminum concentration layer of the kind and location indicated in the titanium alloy material defined in Applicant's claims cannot be formed by an ordinary air oxidation step disclosed in Bomberger or Miyamoto for the following reasons. According to thermodynamics, aluminum is easier to oxidize and be oxidized than titanium. Therefore, if a titanium alloy containing aluminum is air-oxidized in an ordinary manner, an oxide film containing a relatively high amount of aluminum oxide is formed on the surface of the alloy, and an aluminum poor or depleted layer is formed beneath the surface oxide film. In other words, contrary to the requirements of the titanium alloy material of Applicant's claims, a higher

aluminum concentration layer is not formed between the oxide film and the base material.

Applicant's claims require "the Al concentration of the Al concentration layer is 0.3 mass% or more higher than an Al concentration of the Ti-Al alloy" (previously presented Claim 1).

To form the higher aluminum concentration layer between the oxide film and the base material, (a) adjusting (reducing) the oxygen partial pressure and heating temperature, or (b) anodic oxidation is required prior to the ordinary air-oxidizing step.

In Example 3 of the Applicant's Specification (Spec., pp. 16-17), anodic oxidation is performed prior to the air oxidation (Spec. p. 16, 2nd full ¶ ("atmospheric oxidation treatment was given after anodic oxidation treatment"); emphasis added). See also Table 3, Examples 46-59. According to the method disclosed in Example 3, then, a thin passivation film containing a relatively high amount of titanium oxide is first formed on the surface of the alloy by the anodic oxidation. The passivation film prevents aluminum in the base layer from being oxidized too much in the subsequent air-oxidation step. As a result, a higher aluminum concentration layer in accordance with the titanium alloy material of Applicant's claims is formed between the oxide film and the base alloy layer by the air oxidation step. Needless to say, because the base alloy layer described in Bomberger or Miyamoto is not air-oxidized after subjecting it to (a) a reduced oxygen partial pressure and heating temperature, or (b) anodic oxidation, the aluminum concentration layer between the oxide film and the base material is less rather than higher than the base alloy layer.

Applicant's withdrawn method Claim 15 comprises the steps of:

- (1) oxidizing a Ti-Al alloy comprising 0.50 - 3.0 mass% of Al, and
- (2) producing the titanium alloy material of Claim 1.

However, as originally presented, Claim 1 was drawn to a titanium alloy material of far broader scope than the titanium alloy material of the heat exchanger of current Claim 1. In fact, current Claim 1 is not directed to a titanium alloy material at all. Current Claim 1 is

directed to a heat exchanger which comprises a titanium alloy material. When first presented, Claim 15 was withdrawn from further consideration by the Examiner as directed to a non-elected invention following a restriction requirement.

On its face, previously withdrawn Claim 15 not only comprises the step of oxidizing a Ti-Al alloy comprising 0.50 - 3.0 mass% of Al, but it also comprises the step of producing the titanium alloy material of Claim 1. Neither Bomberger nor Miyamoto teaches producing an titanium alloy material defined by any previously presented Claim 1 and certainly does not teach producing the titanium alloy material which forms the heat exchanger of current Claim 1.

During examination, the PTO must give the claims in an application their broadest reasonable interpretation consistent with the specification. *In re Suitco Surface, Inc.*, Slip Opinion, Appeal No. 2009-1418, page 6 (Fed. Cir. 2010); *In re Am. Acad. Of Sci. Tech Ctr.*, 367 F.3d 1359, 1364 (Fed. Cir. 2004); *In re Sneed*, 710 F.2d 1544, 1548 (Fed. Cir. 1983). Claim interpretation is a matter of law. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313 (Fed. Cir. 2005)(en banc). Here, Applicant's Specification teaches that the steps of oxidizing a Ti-Al alloy comprising 0.50 - 3.0 mass% of Al and producing the titanium alloy material defined in Claim 1 which comprise withdrawn Claim 15 should be interpreted to mean far more than simply oxidizing a Ti-Al alloy comprising 0.50 - 3.0 mass% of Al in an oxygen-containing atmosphere at temperatures of ranging from 700°C to 400°C and below.

Applicant's Specification expressly states (Spec., pp. 8-9; emphasis added):

In a titanium alloy material having the aforesaid chemical composition, if an oxide film having a thickness of 1.0-100nm is formed on the surface, a synergistic effect is obtained between the blocking of hydrogen diffusion by the oxide film and suppression of hydrogen diffusion by the parent alloy so that a highly enhanced hydrogen absorption resistance is obtained.

If the thickness of the oxide film is less than 1.0nm, blocking of hydrogen diffusion is poor, so it is difficult to obtain the aforesaid synergistic effect with regard to suppression of hydrogen absorption. On the other hand, if the thickness of the oxide film exceeds 100nm and it is too thick, partial cracks and peeling of the oxide

film may occur during working, so suppression of hydrogen absorption again decreases. Due to this reason, the thickness of the oxide film formed on the surface of the titanium alloy material is preferably 1.0-100nm.

The oxide film may be formed for example by thermal oxidation of a Ti-Al alloy material in an atmospheric environment or in an environment wherein the oxygen partial pressure has been suitably adjusted. By suitably adjusting the heating temperature and oxygen partial pressure in the environment, the film thickness can be controlled. The oxide film may also be formed by performing anodic oxidation in an electrolyte solution such as aqueous phosphoric acid solution. When anodic oxidation is performed, the film thickness of the anode oxide film may be controlled by adjusting the applied voltage or electrolyte temperature. However, the method of forming the oxide film is not limited to these methods.

Furthermore, Applicant's Specification also states (Spec., pp. 9-10; emphasis added):

According to the Inventor's observations, if part or all of the aforesaid oxide film is crystalline, the hydrogen absorption resistance of the titanium alloy is remarkably enhanced. Specifically, whereas the surface oxide film which is formed naturally in the atmosphere has a low crystallinity and a large amorphous part, the oxide film formed by the aforesaid methods is a crystalline oxide film of crystals such as Anatase, Rutile or Brookite on the surface of the Ti-Al alloy forming the bulk part. Due to the formation of this crystalline oxide film, the oxide film is even finer, the hydrogen diffusion blocking effect is enhanced, and hydrogen absorption is more effectively suppressed. This effect is exhibited regardless of the crystalline structure of the crystalline oxide in the oxide film, but Brookite which is orthorhombic is more preferred than Anatase or Rutile which are tetragonal.

The enhancement of hydrogen absorption resistance is marked when 50% or more of the surface oxide film is crystalline. . . .

The crystalline properties of the oxide film may be controlled as desired for example by adjusting the temperature or oxygen partial pressure during the thermal oxidation process, or the applied voltage or electrolyte temperature during the anodic oxidation process. The method of crystallization of the oxide film is however not limited to these methods.

Moreover, Applicant's Specification adds (Spec., pp. 12-13, bridging ¶; emphasis added):

Therefore, concerning the Al concentration layer, the Al concentration and thickness of the Al concentration layer can be controlled as desired by adjusting the temperature and oxygen partial pressure during thermal oxidation as described above. Also, when performing anodic oxidation, the Al concentration of the Al concentration layer can be controlled as desired in a similar way by adjusting the applied voltage and electrolyte temperature. However, the method of forming the Al concentration layer is not limited to the above methods.

Persons skilled in the art reasonably would have understood from the above-quoted teaching in Applicant's Specification that significant control and adjustment of the oxidation temperature and oxygen partial pressure or anodic oxidation is required to produce the claimed oxide film with a critical thickness of 1.0-200 nm, to produce an oxide film with 50 mass% or more of a crystalline oxide, to produce an Al concentration layer having an average Al concentration in a range of from 0.8-6 mass%, to produce an Al content between the Ti-Al alloy and the oxide layer of from 0.8-6 mass%, and to produce an Al concentration in the Al concentration layer which is 0.3 mass% or more higher than an Al concentration in the Ti-Al alloy. Applicant's Specification expressly states that the Ti alloy materials of current Claim 1 cannot be formed naturally in the atmosphere (Spec., pp. 9-10, bridging sentence) by the oxidation processes taught by Bomberger and Miyamoto despite the Examiner's clearly erroneous finding to contrary.

However, the Examiner appears to require some objective evidence to support the teaching in Applicant's Specification. To satisfy that want, the required evidence can be found in Tables 2 and 3 on pages 19 and 20 of Applicant's Specification. Specifically, Table 2 shows that Ti-Al alloys of Examples 31-38 with an oxide film having a thickness of 1.0-100 nm and a crystalline oxide content of at least 50 mass% have superior hydrogen absorption resistance as compared to Examples 22-30 and 39 having an oxide film thickness outside the range of 1.0-100 nm and a crystalline oxide content of less than 50 mass%. Table 3 shows that the Ti-Al alloys of Examples 46-59 with an oxide film having a thickness of 1.0-100 nm need not have a crystalline oxide content of at least 50 mass% to have superior hydrogen absorption resistance as compared to Examples 42-45 if the Al concentration layer has an Al content in the range of 0.8-6 mass%.

The evidence in Applicant's Tables 2 and 3 shows that Ti-Al alloys having an Al content of 0.5-3.0 mass% and an oxide layer formed by natural oxidation in an oxygen-

containing atmosphere do not inherently or necessarily have an oxide film thickness of 1.0-100 nm, do not inherently or necessarily have 50 mass% or more of a crystalline oxide, do not inherently or necessarily have an Al concentration layer between the Ti-Al alloy and the oxide layer of 0.8-6 mass%, and therefore do not inherently have the required superior hydrogen absorption resistance. The evidence in Applicant's Specification shows that the Examiner's findings that prior art Ti-Al alloys which are oxidized in an oxygen-containing atmosphere inherently or necessarily have the structural and chemical elements and properties of the Ti-Al alloy material forming the heat exchangers Applicant claims are clearly erroneous.

The Examiner relies on Taki solely for its teaching that Ti-Al alloys are ideal for use as heat exchangers (OA, p. 5, 1st full ¶). Regardless whether or not it would have been obvious to use the Ti-Al alloy materials taught in Bomberger or Miyamoto in heat exchangers for seawater desalination plants, the combined prior art materials would not have suggested making and using the Ti-Al-alloy materials recited in Applicant's claims in a heat exchanger with any reasonable expectation of successfully making and using the same. *In re O'Farrell*, 853 F.2d 894, 903 (Fed. Cir. 1988); *In re Hoeksema*, 399 F.2d 269, 274 (CCPA 1968). Moreover, heat exchangers used in seawater desalination plants are not subjected to the high temperatures to which Miyamoto's mufflers are subjected and need not have the heat and oxidation resistance Miyamoto's mufflers require.

Finally, the transitional phrase "consisting essentially of" in new Claim 19 closes the titanium alloy material to elements other than those named in the claim which materially alter the basic and novel characteristics and properties of the titanium alloy material identified in the specification. *In re Herz*, 537 F.2d 549, 551-52 (CCPA 1976); *AK Steel Corp. v. Sollac*, 344 F.3d 1234, 1239 (Fed. Cir. 2003). Bomberger identifies only one titanium alloy material which has an Al content between 0.5 and 3.0 mass%. That titanium alloy material

(B120VCA) contains 12.21 mass% V and 10.8 mass% Cr and is a non-preferred beta-type alloy which is significantly more susceptible to hydrogen absorption than are Miyamoto's preferred alpha-type alloys (Bomberger, col. 2, Table I; col. 2, ll. 70-72; and col. 5, ll. 65-75). New Claim 19 excludes titanium alloy materials such as B120VCA which contain a high content of other elements which materially effect the basic and novel characteristics of the titanium alloy materials employed in Applicant's claimed heat exchanger.

Moreover, Miyamoto teaches that Ti-Al alloys without a high V content have significantly different properties from conventional Ti-Al alloys with a high V content (Miyamoto [0005]). Ti-Al alloys with high V content are not suitable for Miyamoto's purposes because they have poor workability (Miyamoto [0005-0007]). Miyamoto teaches that titanium alloy materials useful for its mufflers must have excellent heat-resistance and oxidation resistance (Miyamoto [0008]), are preferably binary-element Ti alloy materials (Miyamoto [0009]), must have an Al content of 0.5-2.3 mass % (Miyamoto [0009]), and preferably have a ratio of the alpha phase of the titanium alloy material over 90% or more by volume (Miyamoto [0009]). The Ti-Al alloy material Applicant claims has an Al concentration layer with an Al content of 0.8-6 mass% which must be at least 0.3 mass% higher than the Al concentration of the Ti-Al alloy, has an outer oxide film 1.0-100 nm thick with a crystalline oxide content of 50 mass% or more, and is used to form heat exchangers for a seawater desalination plant which do not require the heat resistance required when used to form mufflers. Miyamoto's requirements of heat-resistance and oxidation resistance for use in forming mufflers is inconsistent with the structure, composition, and use of the Ti-Al alloy materials in the heat exchangers for seawater desalination plants Applicant claims. In fact, Miyamoto's focus on heat and oxidation resistance would have led persons having ordinary skill in the art away from using the Ti-Al alloy materials it describes in Applicant's claimed heat exchanger for seawater desalination plants comprising a titanium alloy material having

an outer oxide film 1.0-100 nm thick with a crystalline oxide content of 50 mass% or more.

Teaching away is a strong indicator of unobviousness. *KSR International Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007).

Accordingly, the Examiner's new rejections of Claims 1, 7, 9, 11, and 12 under 35 U.S.C. § 103 over Bomberger or Miyamoto in view of Taki should be revered.

Rejection of Claim 8 under 35 U.S.C. § 103 over Bomberger or Miyamoto, Taki and Ledoux

Claim 8 is newly rejected under 35 U.S.C. § 103 over Bomberger or Miyamoto, in view of Taki, and further in view of Ledoux (OA, p. 8, ¶ 6). This rejection also should be withdrawn.

Whether or not Ledoux shows that heat exchangers are known which comprise Ti alloy materials in contact with a steel member, Ledoux does not remedy any of the deficiencies of Bomberger and Miyamoto with respect to the alloy described in Applicant's claims. Moreover, Table 3 in Applicant's Specification shows that the hydrogen absorption resistance of the Ti alloy materials in contact with a steel member used in Applicant's claimed heat exchangers is unexpectedly superior to that of other similar Ti-Al alloy materials with an outer oxide film of different thickness and a different Al content in an Al concentration layer when put in contact with a steel member (Spec., Table 3, p. 20).

Rejections of Claims 13 and 16 under 35 U.S.C. § 103 over Miyamoto in view of Taki

Claims 13 and 16 were newly rejected under 35 U.S.C. § 103 over Miyamoto in view of Taki (OA, p. 6, ¶ 7). The rejections should be withdrawn.

The rejection of Claims 13 and 16 should be withdrawn for the same reasons that the rejections of Claims 1, 7, 9, 11, and 12 over Miyamoto in view of Taki previously stated herein should be withdrawn. By separately rejecting Claims 13 and 16 over Miyamoto and Taki, the Examiner appears to acknowledge that the transitional phrase "consist of" in previously presented Claim 13 and the Al content of 1.0-2.5 mass% in previously presented

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Claim 16 are not described by Bomberger or reasonably suggested by Bomberger in view of Taki.

For the reasons stated herein, Applicant's current claims are patentable over the applied prior art and otherwise in condition for allowance. Accordingly, early Notice of Allowance is earnestly requested.

Respectfully submitted,

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